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Extensional rheology and final morphology of LDPE fibers

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Properties of polymeric fibers are highly dependent on the molecular conformation induced during processing[1]. In this study we investigate the influence of non-linear extensional flow on the molecular conformation of branched semi-crystalline polymers. Such materials show a stress overshoot when stretched at a constant extensional rate[2]. The common explanation is, that at first the backbone stretches until the stress maximum is reached. This is followed by a collapse of the branches causing backbone retraction and thus the decrease in stress[3]. Consequently, one would expect the greatest molecular orientation in fibers quenched at the stress maximum. Indeed we find that this is true and also a more general observation that the final orientation scales with stress at quench in the melt.

[1] Schrauwen B. et al, Macromol. 37 (23), 8618 (2004). [2] Rasmussen, H.K. et al. J. Rheol. 49 (2), 369 (2005). [3] Hawke, L.G.D. et al., J. Rheol. 59 (4), 995 (2015).